

Urban And Agricultural Water Use Efficiency

Overview

Extensive improvements in the efficiency of residential, industrial, and commercial water use can save significant amounts of water and reduce the per capita consumption of water. Water reclamation and desalination provide a drought-proof local water supply that is becoming cost-competitive. Modest improvement of California's agricultural sector in irrigation techniques, cropping patterns, and land retirement solutions can also save significant amounts of water. With technologies and demand management methods available today, California is making headway toward achieving a more sustainable pattern of water use without severe impacts on any particular sector. Toward this end, state water policies are changing to encourage this pattern.

Potential Benefits from Water Use Efficiency

The primary benefit of improving water use efficiency is to be able to cost-effectively meet demand and the growth in future demands for water. Once viewed and invoked primarily as a temporary drought or emergency response to water shortage situations, water use efficiency (conservation and water recycling) has become a viable long-term supply option, saving considerable capital and operating costs for utilities and consumers, avoiding environmental degradation, reducing peak demands, and creating multiple benefits for all sectors. Recently water agencies have begun to explore ocean and brackish water desalination as potential sources of "new" water supply. Without the broad acceptance and implementation of water use efficiency, the reliability of our water supply for all sectors would be questionable and the pressures to develop supplies through surface storage and similar ecosystem damaging measures of the past would increase.

Potential Costs of Water Use Efficiency Programs

The cost of implementing conservation programs is generally less expensive than any other approach to meeting increased demands for water. The cost of reclamation and ocean/brackish water desalination, while significantly lower than in the past, is still higher than such measures as importing surface water using existing facilities, water transfers, and conjunctive use. In addition, water agencies that rely on conservation measures to reduce local water consumption quickly during a drought or emergency consider the loss of this capability a cost. However, determining exact comparisons of costs of increasing supply has been very complicated. CALFED, for example, has attempted to assess the costs of many different scenarios, but their assessments indicate that costs vary considerably based, for example, on the local cost of water, the value of dependable recycled water supplies, and the value of local, more flexible supplies that can be adaptively managed based on local needs and circumstances. There is also uncertainty about the long-term reliability of water-savings

estimates for conservation devices. Further cost analyses, therefore, should be a component of conservation and water recycling project implementation plans.

Description of Key Issues

Urban Water Use Efficiency

The past approach of expanding urban water supplies by tapping ever more distant sources to meet presumed future demands is becoming less realistic and viable in California. Increasingly, water managers are turning to regional and local water use efficiency programs to satisfy urban, agriculture, and environmental needs.

Implementing Best Management Practices (BMPs)

The California Urban Water Conservation Council unites, through a Memorandum of Understanding (MOU), urban water agencies and environmental interest groups in an effort to reduce water consumption through better technology, behavioral changes and water policies. The Council recognizes the importance of implementing cost-effective conservation measures and a responsibility to carry out local water management planning. The Council's fourteen BMPs address residential indoor and outdoor use; commercial, industrial, and institutional use; large landscapes, leak detection, metering, commercial washing machines, conservation pricing, waste water reduction, as well as education and staffing issues. They are comprehensive yet flexible, allowing each area to tailor implementation of each tactic to fit local needs and opportunities. The goal is to implement what works and will produce the greatest amount of cost-effective water savings.

Increasing Potential Urban Water Savings

Some available savings are described below, including those achievable by implementing existing BMPs above the levels specified in the Council MOU.

Promote Low Water Use Landscaping And More Efficient Irrigation.

Landscaping represents 30 to 60 percent of urban water use; more efficient use of landscape water could be encouraged by well designed rate structures. Graywater systems of rain cisterns can conserve much or all of landscape water use in individual applications. Landscape water audits, timers, and xeriscape – based on commonly accepted principles – could also reduce landscape water use by approximately 10 to 15 percent. Statewide, a 20 percent reduction in landscape water use would yield a minimum of 520,000 acre feet.

Retrofit Homes With More Efficient Washing Machines.

Replacing 50 to 100 percent of the average washing machines in use in 1995 with currently available horizontal axis washing machines could reduce current demand by 97,000 to 194,000 acre-feet. Future savings could increase further as even more efficient models come on the market.

Retrofit Businesses And Institutions With Commercial Ultra Low Flow Toilets (ULFTs).

According to a 1997 study by the California Urban Water Conservation Council (CUWCC), savings from commercial ULFT retrofits ranged from 16 to 57 gallons per day (gpd), with wholesale establishments saving 57 gpd, and food stores and restaurants saving approximately 48 gpd. Statewide savings from retrofits could yield 200,000 acre-feet, assuming that 5 million retrofits occur with average savings of 35 gpd.

Implement Existing BMPs For Residential Indoor Use Levels Above MOU Specifications.

A substantial additional increment of cost-effective conservation is achievable by implementing existing BMPs above the levels specified in the CUWCC MOU. For example, potential savings from four indoor residential measures alone (ULFTs, showerheads, faucet aerators, and leak detection) could yield over 300,000 acre-feet.

Implement Existing BMPs For Commercial, Industrial, And Institutional (CII) Water Use At Levels Above MOU Specifications.

CII use represents almost 40 percent of urban water use, or almost 3.5 million acre-feet. Recent studies estimate potential cost-effective savings of 20 to 30 percent, which corresponds to statewide savings of 700,000 to 1 million acre-feet. The Pacific Institute estimates that California industrial and commercial water use could drop nearly 40 percent from current levels using existing technologies. Full implementation of the CII BMP should capture 350,000 acre-feet, leaving at least 350,000 to 650,000 of cost-effective savings available.

Implement Rate Structures to Encourage More Efficient Use of Water

Empirical research has repeatedly shown that rates influence demand for water. Many possible rate structures can be implemented. Two rate structures, for example—seasonal and increasing-block or tiered-block rates—are being used to encourage conservation in areas that have chronic water shortages or limited capacity. Seasonal rates are implemented for water consumed during a utility’s peak-use season. Increasing-block rates use two or more rate blocks with increasing units rates as consumption increases.

Recycling and Reclaiming Wastewater

Recycled water is among the more expensive water supply alternatives. However, when all costs are considered, recycled water offers important secondary benefits, including reliability during droughts, local control, ability to “design” the water quality to meet varying industrial or agricultural specifications, a source of environmental water, reduction of pollution discharges to water bodies and deferred or avoided costs for new or expanded wastewater treatment plants.

The following are examples of the key issues and recommendations identified by the 2003 Water Recycling Task Force Report:

- Increase State funding for reuse/recycling beyond Proposition 50 and other current sources for projects and research.

- While public support for water recycling has generally been very strong, the decision to undertake indirect potable reuse (as distinct from non-potable reuse) needs to be a local decision based on community values, complete and accurate information, and an assessment of the community's water supply options.
- Adopt a California "Appendix J" of the California Plumbing Code to avoid inconsistencies between the international code and other California regulations.
- The Department of Health Services should involve stakeholders in a review of various factors to identify any needs for enhancing existing local and State health regulation associated with the use of recycled water.
- Develop a uniform analytical method to determine the economic benefits and costs of water recycling projects.
- Expand funding for research on recycled water issues.

Desalinating Ocean and Brackish Water

Desalination is the process of purifying sea water or brackish water to drinking water quality standards. The most common methods of desalination are reverse osmosis and distillation. As a result of significant advances in membrane technology over the last decade, desalination has emerged as a viable source of augmenting water supply that in California and elsewhere is now being taken seriously.

While the state should actively consider pilot desalination projects as a way to meet future water needs, it will be important to identify and weigh the costs and the environmental impacts such as brine water discharges and opportunity for coastal development in areas that are currently protected by lack of potable water..

Agricultural Water Use Efficiency

Improving the efficiency of agricultural water use is already a very high priority in many regions in California. Yet the problem of determining actual irrigation efficiencies and how these efficiencies can be improved is extremely complicated. Among the factors that must be considered are soil and land characteristics, crop types, irrigation technology, management practices, and agricultural policies and prices.

A major sustainability goal recommended for the agricultural sector is to optimize agricultural yields (both economic and crop yields) per unit of water consumed without compromising groundwater or surface water quality, or the quantity of water available to maintain natural ecosystems that depend on those water resources. This optimization must take place in the context of explicit goals and resources—farmers will compare the costs of achieving such increases with other economic and social goals.

Improving Irrigation Efficiency

In the aggregate, relatively small decreases in agricultural demand can yield tremendous quantities of water. For example, a small reduction in the percentage of applied water lost to evaporation by switching to more efficient technology or by improved irrigation scheduling can yield potentially significant water savings. Improvements in management

to mitigate soil water stress that does not compromise plant yields can also possibly generate real water.

Evaporative losses are irretrievable and a non-productive use of water. Flood irrigation is estimated to lose 20 to 30 percent to evaporation from open-water surfaces and transpiration by weeds, although in some areas, especially within the eastern side of the San Joaquin Valley, flood irrigation plays a significant role in groundwater recharge. Evaporation losses from sprinkler systems, which are currently used on approximately 34 percent of the irrigated acreage of California, are estimated to be as high as 9 percent, which micro-irrigation systems are estimated to have minimal evaporative losses. According to the Pacific Institute, highly efficient drip and microsprinkler techniques are used on only about 10 to 15 percent of the land. Overall, a one to five percent reduction in agricultural demand due to reduction in evaporative losses or other changes in water use could generate from hundreds of thousands to more than 1 million acre-feet. These changes in irrigation practices could also have a substantial positive impact on water quality by reducing surface runoff, deep percolation, and subsurface drainage. In some areas however, they could also reduce groundwater recharge.

Increasing Use of Market-Based Incentives

A voluntary program of compensated dry-year fallowing of agricultural lands (dry-year options) could generate a substantial dry-year water supply. For example, dry-year fallowing of 5 to 15 percent of the land currently used to grow alfalfa, cotton, and pasture forage in the Central Valley and Colorado River regions could potentially generate 400,000 to 1.2 million acre-feet in those years. These reductions are based on evapotranspiration rates and constitute reduction in consumptive use. Reductions in the volume of applied water are even greater, yielding additional environmental benefits. The CVPIA Least Cost Yield study reached similar conclusions, finding that 1.24 million acre-feet of non-CVP consumptive use could become available through voluntary land fallowing “capped” at 20 percent of existing use in the Central Valley. Estimated costs range from \$55 to \$255 per acre-foot. The same report found that 300,000 acre-feet could be made available within the CVP service area. Applying the same methodology to the consumptively used portion of the Imperial Irrigation District’s water supply would produce another 600,000 acre-feet, for a total of up to 2,140,000 acre-feet. A reasonable minimum estimate of dry-year fallowing can be obtained from the 1991 drought water bank. In that year, 420,000 acre-feet of “no irrigation” contracts (exclusive of “groundwater exchange and multiple response”) were signed by DWR.

Voluntary, compensated retirement of marginal quality lands such as those generally located on the west side of the San Joaquin Valley will have multiple benefits that could help meet the CALFED objectives in many areas, including water quality, water supply reliability, and ecosystem restoration. CALFED’s preliminary analysis showed that a voluntary program of compensated land retirement could generate as much as 1.5 million acre-feet of water at an average cost of \$150 per acre-foot. This cost is significantly less than the projected costs of many other water supply augmentation options currently under consideration.

The 1990 joint federal-state “Rainbow Report” forecast that by 2040, 460,000 acres of San Joaquin Valley lands would be significantly drainage-impaired. It recommended a suite of actions, including land retirement in its drainage management plan. Even assuming the full accomplishment of the other measures, such as conservation and reduction of deep percolation, the Rainbow Report recommended that 75,000 acres be retired from willing sellers. Assuming an average allocation of 2.5 acre-feet per acre, and assuming that .5 acre-feet per acre is necessary for subsequent land management activities, retiring this amount of land from willing sellers could generate 150,000 acre-feet of water. Voluntary retirement of 75,000 acres is projected to occur pursuant to the CVPIA, even in the absence of a CALFED solution.

There are however, significant concerns regarding land fallowing within rural communities and farm labor interests. The long-term fallowing of 20% of the total land base could result in significant economic impact to those local economies and communities. Additionally, the use to which the saved water would be put could result in environmental impacts to both the environment in the area of the fallowing and the new place of use.

These figures are preliminary only and provided here for illustrative purposes. The degree to which market-based voluntary dry-year fallowing and voluntary land retirement should be implemented, and under what conditions, deserves far more exhaustive analysis.

Implementing Efficient Water Management Practices (EWMPs)

In response to the Agricultural Efficient Water Management Practices Act of 1990, the DWR and others developed voluntary Efficient Water Management Practices for agricultural water suppliers. The agricultural memorandum of understanding (MOU) has been signed by 50 agricultural water agencies representing 4.7 million acres as a commitment to adopt the EWMPs. These EWMPs include six “universally applicable” EWMPs and a dozen “conditionally applicable” EWMPs for signatory agencies to address in submitting required water management plans to the Agricultural Management Council. The measures include automation of canal structures, construction and operation of tailwater reuse systems, and installation of water meters to measure the volume of water delivered to individual water users. Accurate measurement of water use is critical to the design and operation of effective water management plans. Agricultural water conservation programs should include agricultural efficient water management practices that improve water quality, timing, and in-stream flows.

Achieving CALFED Quantifiable Objectives

Similar to implementing EWMPs, achieving CALFED quantifiable objectives is another approach to improving water use efficiency. CALFED’s water use efficiency element is based on the recognition that although efficiency measures are implemented locally and regionally, the benefits accrue at local, regional, and statewide levels. The purpose of the agricultural water use efficiency element is to develop and carry out a prioritized, strategic, and aggressive program for the achievement of the CALFED objectives throughout the CALFED solution area, though these strategies and objectives are

applicable statewide. CALFED recognizes that a strong emphasis on efficiency is already reflected in many outstanding water use efficiency efforts throughout the state; California irrigation districts and growers have implemented many pioneering methods to manage water supplies and improve efficiency. The CALFED agricultural element is structured to build on and expand these existing efforts. The strategy—developed by a multi-disciplinary Technical Team that includes experts in water conservation, water quality, resource economics, irrigation engineering, and local operations expertise—is grounded in several essential principles, including the following:

- The Central Valley consists of numerous sub-regions, each with its own needs and local hydrologic distinctions.
- Locally-based actions can help CALFED achieve multiple, statewide objectives related to water quality, quantity, and in-stream flow and timing.

In meeting these items, a specific listing of CALFED related goals that are affected by irrigation water management practices have been identified. These are called Targeted Benefits. For water use efficiency, CALFED has identified 196 Targeted Benefits that relate to water quality, quantity, and in-stream flow and timing.

Major Recommendations for Water Use Efficiency

The DWR needs to develop and take responsibility for playing a more aggressive role in water use efficiency throughout the state. The size of the DWR staff devoted to water use efficiency and related actions must be increased in keeping with the future needs of the state and the following responsibilities must be enhanced within the department:

1. Fully implement existing BMP and EWMP water-efficiency provisions, including the establishment of a state certification system for agencies with approved implementation of BMPs and EWMPs.
2. Implement the key issues and recommendations of the California 2003 Recycled Water Task Force.
3. Provide oversight to ensure consistency statewide including areas not covered by CALFED or membership in the CWUCC or BMP area.
4. Provide incentives including grants for installing efficiency measures where BMPs and EWMPs are not considered cost effective from a local point of view but may be beneficial in preserving water supply and quality statewide.
5. Support programs that encourage the development of new cost-effective water-savings equipment, technologies, and practices.
6. Evaluate the applicability of ocean and brackish water desalination for different uses.
7. Establish criteria that link water use efficiency practices as an integral component in the consideration of water subsidies.
8. Establish a link between water saved through efficiency and water to benefit the environment.
9. Implement new rate structures to encourage more efficient use of water.
10. Promote voluntary dry-year fallowing and/or crop rotation with the provision that a comprehensive analysis of any resulting impacts to the communities in the area

- of fallowing, the environment in those areas as well, as the place and type of use of the saved water, will be carried out and incorporated into Bulletin 160 updates. Dry-year fallowing allows growers to keep high-value permanent crops productive, keeps the remaining agricultural land in production over the long-term, and provides an important source of income for farmers. Crop rotation can help maintain soil sustainability.
11. Promote voluntary land retirement. Halting the farming of land with severe drainage problems increases water efficiency and decreases pollution.

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